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A Review of Literature on Adaptive Capacity and Sustainability of Community Water Projects

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Abstract

Community water projects are created for provision of sustainable water services, and their sustainability relies on the ability of communities and responsible institutions to adapt to varying conditions in the environment, operation and society. This research sought to review the existing literature on the adaptive capacity and sustainability of community water projects. A systematic literature review methodology was adopted to find, screen and analyse the literature on this subject matter published in the years 2020 through 2026. Literature on this topic was searched for in Scopus, Web of Science, ScienceDirect, EBSCOhost and Google Scholar using the combination of keywords relating to adaptive capacity, community water projects and sustainability. The search resulted in the identification of 412 records, among which only 56 were selected after screening using predefined criteria and subjected to thematic synthesis. The final literature review yielded 20 articles about adaptive capacity and sustainability and therefore formed the body of evidence. From the analysis of the reviewed literature, it can be concluded that adaptive capacity is linked to the ability of community water projects to anticipate changes, adapt to them, mobilise resources and learn from challenges. The findings have shown that sustainability will be improved when there is the ability for water projects to adapt to environmental pressures and operational interruptions and still keep its functions and continuity of delivery. It has been found that the definition of the adaptive capacity is applied differently by various authors, which creates conceptual and methodological variability in its assessment. All in all, the literature shows the significance of the adaptive capacity in ensuring sustainability of the community water projects.

Keywords: *Adaptive Capacity, Sustainability, Community Water Projects, Water Services, Systematic Literature Review*

INTRODUCTION

Community water projects are vital for increasing access to water services where infrastructure and institutions are controlled at the local level. Sustainability in community water projects is seen in the continued delivery of water services, the functionality of infrastructure, and sustainability of the projects through the ability to keep running. Foster et al. (2020) indicate that

the functionality of rural water supply systems is crucial in determining if the water infrastructures have delivered their intended services. Dinka and Nyika (2024) similarly show persistent problems in water and sanitation progress in sub-Saharan Africa, emphasizing the need for sustaining water systems functionality.

Sustainability in community water projects should not be analyzed only from the perspective of the construction of the infrastructure. Machado et al. (2022) illustrate that the long-term sustainability of community-managed water supplies depends on the conditions that sustain the functionality of the systems beyond implementation. Silva (2022) further points out that sustainability in the water sector involves considering the integration of sustainability factors in water system activities.

Adaptive capacity offers an efficient perspective on the response of community water projects in cases where there are changes in the conditions within which the provision of service takes place. According to Chapagain et al. (2025), adaptive capacity has been defined from various perspectives and indicators as a result of the capability of systems and communities to cope with changing circumstances. According to Dilling et al. (2023), adaptive capacity influences the manner in which water systems respond to incremental and transformative pressures; therefore, it is critical in terms of ongoing water services' management.

The interaction between adaptive capacity and sustainability is especially significant in the case of community water projects operating in changing conditions. As observed by Pahl-Wostl et al. (2020), water governance needs capacity for the handling of complex management problems and changing conditions. According to Pot (2023), preparedness for changing conditions is associated with decision-making about water infrastructures. According to Weber (2023), the attributes of adaptability, learning, and responsiveness can be considered as significant factors through which organisations can address the changes in environment and achieve sustainable results. As mentioned by Hassel and Cedergren (2025), adaptive capacity of organisations can be evaluated via methodologies that include an analysis of how organisations address unexpected situations.

The current paper is concentrated on the association between adaptive capacity and sustainability of community water projects. The point is that systematic reviews can help in bringing together scattered researches, while Xiao and Watson (2019) pay attention to the structured literature synthesis.

Statement of the Problem

Water projects in communities are meant to ensure ongoing water supply services, yet the presence of water infrastructure does not necessarily mean its sustained functionality. Foster et al. (2020) describe variations in functionality of hand pump water sources in different regions, thus showing the problem of sustaining water services once the infrastructure has been put in place. In turn, Gedamu et al. (2025) note some recurring factors influencing the sustainability of water schemes in rural areas of sub-Saharan Africa.

This is an important issue because water projects work in conditions that may vary after the project is implemented. Machado et al. (2022) prove that sustainable functioning of the water sources that are managed by communities is dependent on the conditions of functioning. At the same time, Pahl-Wostl et al. (2020) prove that water governance systems have complex management issues.

While adaptive capacity is increasingly talked about in water and sustainability literature, the nature of the connection between adaptive capacity and sustainability of community water projects continues to be conceptually varied. For instance, Chapagain et al. (2025) identify

notable differences in the components and metrics considered in describing adaptive capacity. Weber (2023) also indicates that there have been various conceptual perspectives taken regarding the association between organisational attributes related to adaptive capacity and sustainability.

This methodological challenge is also present in the way that adaptive capacity is measured. Hassel and Cedergren (2025) evaluate measurement approaches for organisational adaptive capacity and reveal variation in measurement methods. According to Dilling et al. (2023), adaptive capacity operates differently in water systems based on the pressures faced and adjustments required.

It is therefore important to conduct a systematic synthesis in order to determine what the current literature reveals about adaptive capacity and sustainability of community water projects. As mentioned by Snyder (2019), a systematic literature review may provide a well-defined process for synthesising fragmented research. As pointed out by Page et al. (2021), systematic reviews should include identification, screening and reporting of evidence.

LITERATURE REVIEW

Theoretical Framework

Systems Theory

Systems Theory is an appropriate theoretical framework to analyse the sustainability of community water projects since a water project comprises interconnected elements whose functioning impacts the functioning of the entire system. Von Bertalanffy (1968) describes systems as organized units whose parts interact both with one another and with their surroundings. Sinha et al. (2023) use a systems approach to water infrastructure and emphasize interactions within social, ecological and technological aspects of infrastructure throughout its life cycle.

Adaptive capacity in terms of Systems Theory means the way a water project adapts in case of changing circumstances influencing the system. According to Pahl-Wostl et al. (2020), water governance systems have to possess adaptive capacity to cope with complex challenges in management. In the same way, Dilling et al. (2023) prove that adaptive capacity influences the ability of water systems to adapt in various ways.

Thus, the theory is appropriate since it enables one to regard adaptive capacity as a system capacity that allows adjustment while preserving basic functions. Weber (2023) associates organizational flexibility, learning and responsiveness with sustainability outcomes. Pot (2023) also illustrates that preparing water infrastructure for future conditions involves making decisions based on system needs.

Sustainable Development Theory

Sustainable Development Theory offers an additional approach through which one could explore if community water projects are able to meet current water needs as well as preserve the conditions which would be necessary for water provision in the future. In his work, Thiele (2024) describes sustainability as a multidimensional phenomenon focused on sustaining desirable conditions. In his research, Silva (2022) shows that sustainability within the water industry implies incorporating sustainability into water-sector practice.

In community water projects, sustainability involves continued water provision, functionality of water infrastructure, financial sustainability, community satisfaction, and environmental sustainability. Foster et al. (2020) reveal the importance of infrastructure functionality for sustained water provision. Dinka and Nyika (2024) show that there is still a need to improve water and sanitation results, thus highlighting the significance of sustainable water services.

This theory can help explain the connection between adaptive capacity and sustainability. Piotrkowska et al. (2025) find preparedness and resource mobilisation to be two components of social adaptive capacity that are necessary for sustainable adaptation. Weber (2023) finds a connection between the capacity to adapt and sustainable results as well.

Empirical Review

Weber (2023) conducted a systematic review on sustainability in organizational settings and revealed the relevance of adaptability, learning and responsiveness in terms of dealing with changes in those settings. This is important in the case of community water projects since sustainability of service provision would imply the ability to adjust the organization process under new circumstances. The paper thus contributes conceptually to the investigation of adaptive capacity as a condition of sustainability.

The findings of Nelson et al. (2021), who conducted a realist review on water and sanitation interventions in low and middle-income countries, show that community engagement could have an impact on the outcomes of infrastructure development and service sustainability if there was a possibility of adjustment of communities to project demands. The results thus justify the hypothesis that the condition of sustainability includes adjustment of local systems to provide services.

Machado et al. (2022) have conducted a review of community-managed water systems and found that several factors influence the sustainability of such systems. The above-mentioned finding confirms the relevance of the adaptive-capacity framework since continued adjustments are necessary for sustainability. Similarly, Foster et al. (2020) have shown that continued functionality plays a key role in the provision of water services.

Piotrkowska et al. (2025) have studied social adaptive capacity in the context of sustainable adaptation and determined that preparedness and resource mobilisation are crucial for this type of capacity in the face of changes. In this case, these issues are relevant for community water projects due to the possibility of unexpected stresses and the need for adjustment and mobilisation of existing resources. Therefore, the above-mentioned study provides additional evidence of the connection between adaptive capacity and sustainability.

The synthesis of the literature on the topic of adaptive capacity to climate change carried out by Chapagain et al. (2025) reveals significant differences in terms of how the concepts, dimensions, and indicators were defined in different studies. Such result is critical for understanding the challenges of community water projects because lack of consistency in conceptualization complicates the comparison of the results. At the same time, it means that it is essential to properly define the concept of adaptive capacity in order to be able to examine its connection with sustainability. The similar idea was proved by Hassel and Cedergren (2025).

The study by Pot (2023) examines the influence of water infrastructure investments and preparations for future conditions on the ability of water systems to adapt to the future needs. In this way, the research proves the importance of forward-looking capacity for maintaining the water system performance. Within the framework of community water projects, such capacity may be an important component of sustainability. Similar idea is proved by the work of Pahl-Wostl et al. (2020).

According to Adger (2023), adaptive responses in vulnerable communities undergoing environmental shocks are addressed and the implications of failure by the communities to adapt to such challenges are presented. This literature review proves the need for adaptability in order to provide essential services to communities in varying environments. The implications of this are that in the case of community water projects, the adaptability response to environmental

pressure could be instrumental in sustaining service provision. According to Adger (2023), adaptive response is also necessary where communities depend on essential services within varying environments.

A systematic review was carried out by Gedamu et al. (2025) on barriers to sustainability of rural water schemes in sub-Saharan Africa. The results prove that sustainability continues to be a problem in rural water systems and that sustainability continues to depend on factors other than the initial establishment of the projects. This literature review emphasizes the need to look at adaptive capacity as a factor affecting sustainability. In this regard, long-term sustainability depends on factors other than the initial establishment of the project.

The review of functional information about hand pumps from sub-Saharan Africa and Asia-Pacific by Foster et al. (2020) reveals that functionality of water-points depends on time and context. It emphasizes the difference between setting up the infrastructure and sustaining its service function, which is the core of the current review, as the adaptive capacity is defined in terms of ability to cope with the challenges to sustaining functionality of the infrastructure. Dinka and Nyika (2024) contribute another piece of evidence that sustained water-service outcomes are an issue of sustainability.

Silva (2022) conducted the review of sustainability implementation in the water sector and concluded that sustainability should be addressed throughout water sector operations. Thus, the evidence shows that sustainability is not a one-off project outcome but an ongoing process. Therefore, the current review focuses on adaptive capacity as the ability to modify operations according to changing circumstances to ensure sustainability. Similarly, Thiele (2024) considers sustainability as an ongoing condition.

Research Gap

The literature presents a conceptual gap, as adaptive capacity has not been uniformly defined within various studies. The presence of changing concepts, dimensions and indicators of adaptive capacity is described by Chapagain et al. (2025), whereas the variability in research methods related to assessing adaptive capacity is highlighted by Hassel and Cedergren (2025).

Also, there is a gap regarding context, since many pieces of evidence are provided in relation to the wide water systems, organisational contexts or climate adaptation, rather than community water projects. For instance, Dilling et al. (2023) study large urban water systems, whereas Machado et al. (2022) concentrate on community-managed water supply. Integrating the evidence obtained from various contexts can show which adaptive-capacity aspects are relevant for the sustainability.

Methodologically, the variability in research approaches and methods of assessment presents another gap. The variability in research methods related to assessing adaptive capacity is identified by Hassel and Cedergren (2025), whereas the importance of systematic review methods for synthesising fragmented evidence is highlighted by Snyder (2019). The present review deals with this gap in terms of structured literature search and screening.

The problem of measurement is illustrated by differences between studies using diverse measures of adaptive capacity. As Chapagain et al. (2025) state, the dimensions and indicators are diverse among research works. Such a difference illustrates that future empirical studies should develop definitions of adaptive capacity that are clear from both theoretical and practical viewpoints related to community water projects. Also, Xiao and Watson (2019) stress the necessity of clear procedures for systematic literature review.

FINDINGS AND DISCUSSION

Evidence on Adaptive Capacity and Sustainability

The review reveals that the adaptive capacity has been proven to be associated with the capability of water projects and systems to adapt to changes while continuing performing their roles in providing service. According to Weber (2023), flexibility, learning, and responsiveness have been proven to be correlated with sustainability in an organisational context. Likewise, Dilling et al. (2023) prove that adaptive capacity affects the reaction of water systems to changes of different nature.

Additionally, it is evident that adaptive capacity promotes sustainability due to preparedness and adjustment. Piotrkowska et al. (2025) reveal that preparedness and resource mobilization are important elements of social adaptive capacity. Pot (2023) states that preparing water infrastructure for upcoming conditions will enable its sustainable functioning.

Moreover, it should be noted that adaptive capacity implies learning and adjusting to changes. Weber (2023) reveals that learning and flexibility are among the qualities which characterize adaptation to changes. Hassel and Cedergren (2025) prove that assessing the adaptive capacity of an organization requires taking into account the anticipation of unexpected situations.

Furthermore, the review identified that sustainability relies on the functionality of the project and not on the project establishment. Foster et al. (2020) prove that functionality of water supply can change even when infrastructure is established. Likewise, Machado et al. (2022) also highlight conditions in the long run which have an influence on sustainability of community-managed water supply systems.

Adaptive capacity proves to be a particularly important aspect for cases when water projects face environmental challenges. Adger (2023) stresses the importance of having adaptive capacity in vulnerable communities which are under the threat of environmental shocks. Nazari et al. (2026) prove that long-term water resource sustainability needs taking into account changes.

Also, the review identified that the relationship is context-specific since the concept of adaptive capacity is understood from several aspects. Chapagain et al. (2025) demonstrate significant differences in concepts, dimensions and indicators. Likewise, Hassel and Cedergren (2025) also

Table 1: Synthesis of Empirical Evidence

Study	Context	Key Evidence Relevant to adaptive capacity
Weber (2023)	Organisational sustainability	Flexibility, learning and responsiveness support sustainable outcomes.
Nelson et al. (2021)	Low- and middle-income countries	Community-level capacity and continued service arrangements affect service longevity.
Machado et al. (2022)	Community-managed water supply	Long-term functioning depends on conditions supporting continued operation.
Dilling et al. (2023)	Water systems	Adaptive capacity shapes responses to changing conditions.
Piotrkowska et al. (2025)	Social adaptive capacity	Preparedness and resource mobilisation support sustainable adaptation.
Chapagain et al. (2025)	Adaptive-capacity literature	Concepts, dimensions and indicators vary across studies.
Hassel & Cedergren	Organisational adaptive	Assessment methods vary according to

(2025)	capacity	context and type of change.

In the reviewed studies, the common theme that emerges is that adaptive capacity serves as the foundation for further adjustment as conditions influencing the water project change. While Nelson et al. (2021) provide an example of the relevance of community capacity to longevity of services, Machado et al. (2022) specifically explore the influence of conditions on long-term sustainability of community-managed water provision.

Furthermore, it becomes clear from the reviewed literature that adaptive capacity has a multidimensional character. In their review, Chapagain et al. (2025) identify multiple dimensions and indicators, while Weber (2023) mentions flexibility, learning and responsiveness among other characteristics. Future assessments of adaptive capacity in community water projects should include indicators which correspond to the specific context of each project.

Finally, the evidence supports systems approach to understanding sustainability. It is illustrated by the examples of Pahl-Wostl et al. (2020), who point out the need for the capacity to cope with complexity in water governance systems, and Sinha et al. (2023), who conceptualize water infrastructure in terms of inter-related social, ecological and technical dimensions.

In addition, the results suggest that sustainability is improved when water projects have the capacity to be prepared for any issues that may arise and take action to counteract them before the disruption lasts too long. Pot (2023) ties planning for the future to the infrastructure of water, whereas Piotrkowska et al. (2025) mentions that preparedness is an element of social adaptive capacity. The results imply that anticipation is an important element of adaptive-capacity.

Lastly, the findings imply that methodological clarity is still crucial. Hassel and Cedergren (2025) demonstrate the differences in methodologies for measuring adaptive capacity, and Chapagain et al. (2025) point out the differences in indicators. However, the variety of methodologies should not undermine the findings; rather, it suggests that future research should specify the elements of adaptive capacity measured in relation to sustainability.

Discussion

The results prove the validity of the hypothesis that adaptive capacity has something to do with sustainability of community-based water projects. This relationship is expressed through the ability to forecast changes, adapt responses to the situation, learn and resource mobilization to ensure the continuation of service delivery. The evidence of flexibility, learning and responsiveness provided by Weber (2023), and the evidence of preparedness and resource mobilization provided by Piotrkowska et al. (2025).

Moreover, the results confirm the hypothesis that adaptive capacity is not an innate characteristic and needs to be taken into consideration. It has been shown by Dilling et al. (2023) that different types of changes require different approaches to adaptive response. Hassel and Cedergren (2025) have confirmed the need for different approaches to the methods of assessment depending on the conditions and the nature of unexpected changes.

In general, the evidence analyzed confirms the existence of a stable conceptual relationship between adaptive capacity and sustainability, even though its strength and form depends on context and methods of measurements. The importance of flexibility, learning and responsiveness has been confirmed by Weber (2023), the importance of conditions for sustainability – by Machado et al. (2022). The literature therefore supports further empirical examination using context-specific indicators of adaptive capacity and clearly defined sustainability outcomes.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Adaptive capacity is one of the elements that contribute to the sustainability of community water projects. Community water projects exist under varying conditions that may change over time, and their sustainability requires them to be able to adapt to those changes while still delivering water services.

In addition, the review notes that the adaptive capacity is shown through preparedness, flexibility, learning, responsiveness, adjustment, and resource mobilization where conditions change. These qualities enable community water projects to keep functioning even under new demands from changes in environmental, operational or social conditions.

Furthermore, the review states that sustainability goes beyond building water infrastructure. For community water projects to be sustainable, they have to deliver services continuously, keep their infrastructure working, maintain financial sustainability, make the community satisfied, and ensure environmental sustainability.

Finally, conceptual and methodological variation remains a major issue in the study of adaptive capacity. Future studies should therefore define the construct clearly, use contextually appropriate indicators and examine its relationship with sustainability through systematic and transparent research procedures.

Recommendations

Community water project managers should strengthen preparedness and adjustment mechanisms that enable projects to respond to changing operating conditions. Pot (2023) emphasises preparation for future water-system conditions, while Piotrkowska et al. (2025) identifies preparedness as an element of adaptive capacity. Project planning should therefore consider possible changes in environmental and operational conditions rather than relying only on assumptions made during initial implementation.

Future research should develop context-specific measures of adaptive capacity for community water projects. Chapagain et al. (2025) show that adaptive-capacity indicators vary across studies, while Hassel and Cedergren (2025) demonstrate variation in assessment methods. Such measures should clearly distinguish preparedness, adjustment, learning, responsiveness and resource mobilisation so that findings can be compared across projects and settings.

Researchers should also undertake empirical studies that test the relationship between adaptive capacity and sustainability using clearly defined indicators and appropriate research designs. Snyder (2019) supports systematic approaches to evidence development, while Shaheen et al. (2023) emphasise transparent and reliable review procedures. Greater consistency in measurement would improve comparison of findings across community water projects.

Further systematic reviews need to keep the evidence up-to-date with any emerging studies. Page et al. (2021) stress on the importance of transparently keeping systematic evidence updated and reporting, whereas Xiao and Watson (2019) have provided guidelines for the maintenance of structured reviews. Periodic synthesis may also help in understanding the evolution of the concept of adaptive capacity and its association with sustainability in different community water contexts.

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